Sizing of inject outlets

The elements: air velocity, flow direction, and the induction of the inlet with the room air, are decisive for obtaining a comfortable environment in conditioned rooms.

Forcing heated- or isotherm inlet air to floor level whilst still avoiding draft in the occupied zone can be very difficult. If the air circulation is too weak, this will lead to stratification. There can be significant gradients between ceiling and floor level. The traditional approach, using a few grilles, often results in the inlet air not being distributed uniformly over the whole room.

When the inject outlet was conceived, we placed great emphasis on creating an outlet suitable for ensuring uniform air conditions in the ventilated area, even when dealing with ventilation only, i.e. no differential temperature available to give an impulse to the inlet air. With Euro Air Inject outlets this is achieved by using the whole length of outlet as a diffuser. This special system makes it possible to introduce inlet air without any draught inconveniences, even at exit velocities from the punched orifices of up to 15 m/s. The high velocity present through all the small injection holes secures a degree of induction much higher than that of traditional diffusers. This means that the Euro Air Inject system has a much better ability to "mix with the room air", thereby creating a uniform air velocity and temperature gradient in the entire room.

When applying the principle of "stirring ventilation" the air is introduced with a high velocity from a position outside the occupied zone, contrary to displacement ventilation, where the outlets are often quite close to the occupied zone.

To ensure the best possible conditions the air has to de-accelerate to a velocity of approx. 0,1 -> 0,3 m/s in the occupied zone, depending on room category, comfort demands, personal insulation i.e. type of clothing. Please turn to page 4.1.3 for room category definition.

With the Euro Air inject system the air distribution can be carried out in different ways. If the orifice direction is horizontal to the room (chart 16, centre picture) or downward into the occupied zone (chart 16, bottom picture), a jet of air is achieved. This jet initially serves to "bring with it" a substantial amount of the ambient air surrounding the outlet. Further along the trajectory, the turbulence caused by the "jet breaking up" will cause the surrounding air mix with the inlet air.

If the Coanda-effect is used (by orientating orifices against ceiling or other flat surface) the jet will create a local negative pressure which in turn will have the effect of making the jet of air "stick to the ceiling" and a longer throw can be achieved (by a factor $\sqrt{2}$).

Basic terms

On the following pages the most important terms for dimensioning of the EURO AIR Inject system will be described.

Outlet velocities

The static pressure (positive) inside the Inject outlet forces the air through the small orifices at a high velocity and at the same time the static pressure keeps the round (or half round) shape of the outlet.

Sizing of outlets with sewn-in slot diffusers

The exit velocity through the orifices has great influence on the degree of mixing with the room air achieved, and the throw gained. The pattern of the holes is standardized, so that a given static pressure always gives the same exit velocity (However, as always options are possible, please call us if you have a application calling for a non-standard selection).

Inlet surface
EURO AIR has determined the standard diameter and the pattern of the holes. A change in the orifice surface can only be made by changing the number of hole rows (as a rule, but options are possible, see above). Euro Air uses the number of hole rows as a parameter for the orifice surface.

Air volume
Normally the air volume given is for the entire length of the outlet. However, the possibility also exists that the Inject outlet is used for part air transfer, and part introduction of inlet air. In this case, the outlet diameter must be sized for the total airflow, whilst the number of hole rows is found using only the "inject part" of the air flow.

Air inlet direction
The orientation of the orifices can be given as a vector, or alternatively as a time (O'clock). In our standard 12:00 equals 0 / 360 degrees, 15:00 equals 90 degrees, 18:00 equals 180 degrees, etc.

The orientation of orifices is always given with refence as:
Section view: Seen into outlet in direction of airflow.

Products
EURO AIR uses the following materials for Inject Socks:

Polyester weave, coated on both sides, airtight, fireclass B2 (DIN 4102).
Polyester weave, coated on both sides, airtight, self extinguishing material, fireclass B1 (DIN 4102).

Calculation Inject outlets

Necessary data:
- Airflow each fan [m³/h] respectively type / number of fans / connection diameter [mm]
- Total pressure available for outlets [Pa]
- Max. length of sock [m]
- Inlet temperature [°C]
- Room temperature [°C]

The above mentioned data is absolutely necessary for a correct technical layout. For a specific application it is also necessary to give following additional information:

- Size of room L x W x H [m]
- Max. air velocity in the occupied area allowed [m/s]
- From the given data the room category is chosen 1-3 (page 4.1.3)
- Dynamic pressure [Pa] (diagram 1, page 14)
- Max. airflow per running metre Ventilation outlet [m3/h] (page 4.1.3)
- Max. cooling capacity per running metre Ventilation outlet [W] (page 4.1.3)

If you need any assistance with the dimensioning please make an inquiry to your local EURO AIR department. Fax or mail the enclosed specification sheet (chart 20). Euro Air will get back to you as soon as possible, with a computer simulation of your project.

Example:
Heating of an all-round room.

Given:
Room dimensions: L=23 m, W=12 m, H=5 m, airflow=6.500 [m³/h], TR =22 °C, ΔT = 10 K, i.e. heating capacity app. 22.100 W, air velocity in the occupied area max. 0,2 m/s, static pressure = 90 Pa. Length of the Inject Sock chosen to 22 m due to room dimensions.

Solution:
1. First the maximum airflow per running metre is determined.

$$\text{Airflow each metre} = \frac{6500\ m^3/h}{22m}$$

$$= 295{,}45\ m^3/h.\ \text{per metre}$$

2. Number of holerows
   By 90 Pa read in chart 17, page 42 = 12 pcs.

3. Diameter of Inject outlet
   Found in chart 4 = Ø 630 mm

4. Result: Inject outlet Ø630,12 hole rows, orifice orientation 18:00 o'clock / 180 degrees. Here, the orifice orientation is directly downwards, with hole rows centred @ 18:00 o'clock / 180 degrees, all hole rows share same mutual distance centre-centre.

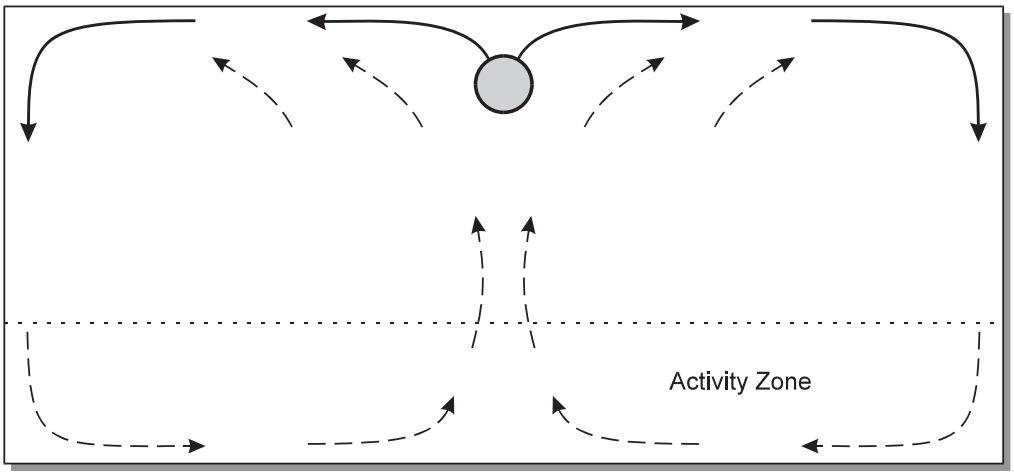
EURO AIR recommend to work with a static pressure inside bracket 70 to 120 Pa and to keep inlet velocities below 8 m/s. If these values are exceeded, please contact your local EURO AIR office, who will help you by finding the correct solution.

Half round inject outlets
The half round Inject outlets differs only by it's shape from the round Inject outlet, so only when sizing diameter, please turn to charts 10,11 or 12 instead of 3,4 or 5.

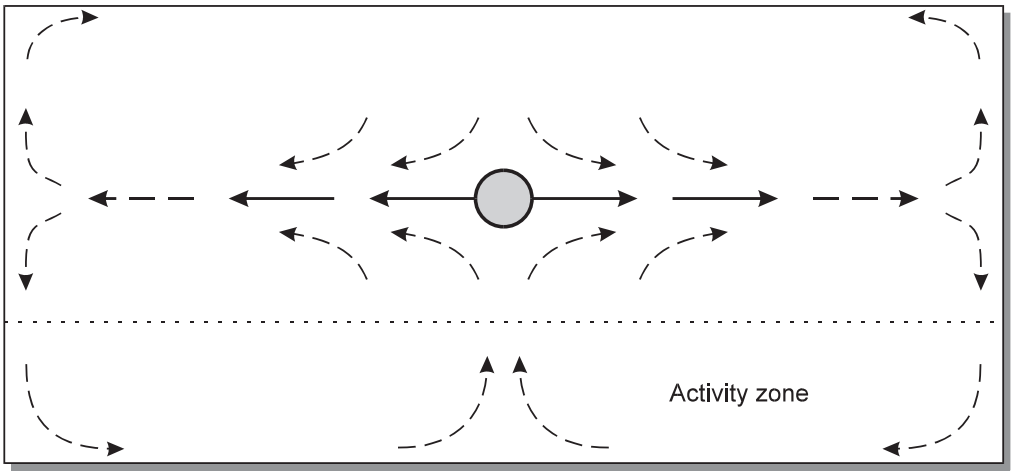
Euro Air Special service
As for the slot diffuser outlets, we have the experience and software needed to simulate air velocities at any given distance from the outlet. Please do not hesitate to call us, we will be only too happy to provide this service.

Sizing, Chart 16

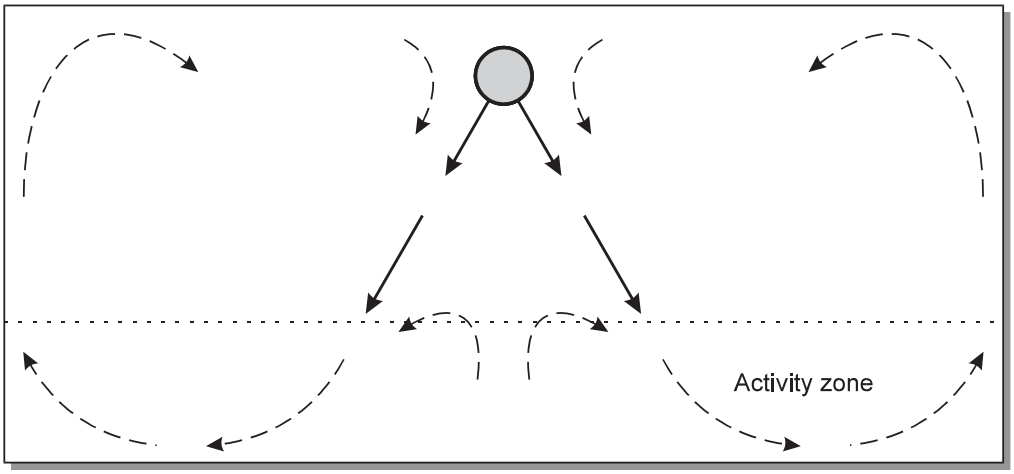
Air flow patterns, inject outlets



Picture : Principle in stirring ventilation, free jet against ceiling



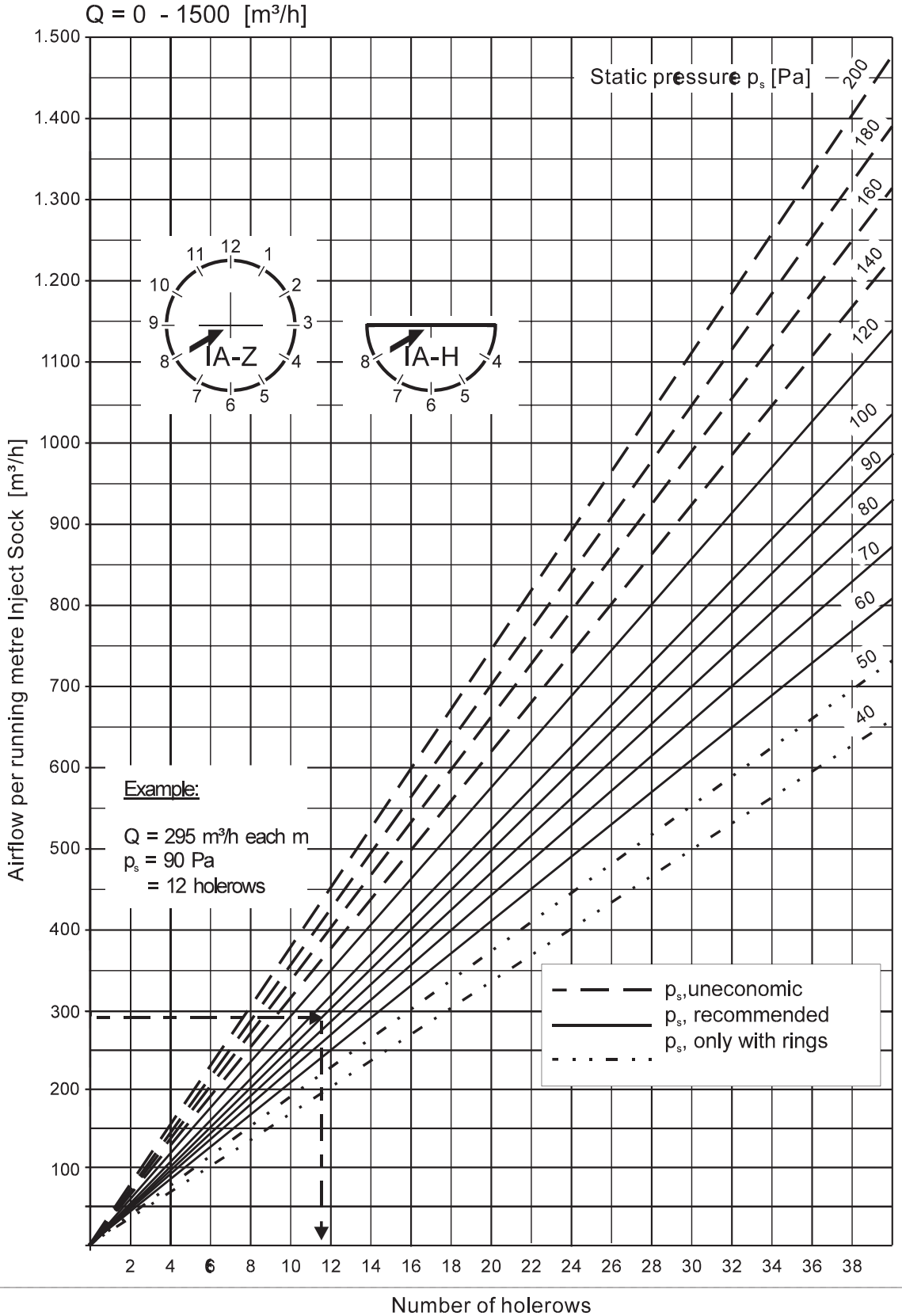
Picture : Free jet into the room



Picture : Free jet into the activity zone

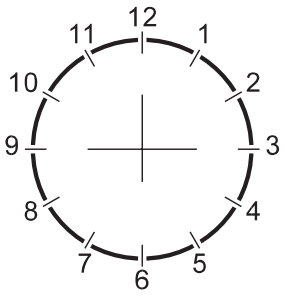
Sizing, Chart 17

Selecting number of hole rows



Sizing, Chart 18

Orientation of hole rows



Holerows placed in accordance to the clock

e.g.: Holerows (nozzles) placed at 5 and 7 o'clock. This means that these are arranged symetrically around 5 and 7 o'clock.